National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1643d

Trace Elements in Water

This Standard Reference Material (SRM) is intended primarily for use in evaluating methods used in the determination of trace elements in fresh water. SRM 1643d consists of approximately 250 mL of filtered and acidified water in a polyethylene bottle, which is sealed in an aluminized plastic bag to maintain stability. SRM 1643d simulates the elemental composition of fresh water. Nitric acid is present at a concentration of 0.5 mol/L to stabilize the trace elements.

The certified values for twenty-six elements in SRM 1643d are listed in Table 1. The noncertified values for an additional four elements are provided in Table 2 for information only. The analytical methods used for the characterization of this SRM are given in Table 3. All values are reported as mass concentrations [1].

NOTICE AND WARNINGS TO USERS

Expiration of Certification: This certification is valid for two years from the date of shipment from NIST. Should any of the certified values change before the expiration of the certification, purchasers will be notified by the NIST. Return of the attached registration card will facilitate notification.

Precautions: The SRM should be shaken before use because of possible water condensation. To prevent possible contamination of the SRM, do not insert pipets into the bottle. Samples should be decanted at a room temperature of 22 °C ± 5 °C. After use, the bottle should be recapped tightly and returned to the aluminized plastic bag, which should be folded and sealed with sealing tape. This safeguard will protect the SRM from possible environmental contamination and long-term evaporation.

The accuracy of trace element determinations, especially at the μg/L level, is limited by contamination. Apparatus should be scrupulously cleaned and only high purity reagents employed. Sampling and manipulations, such as evaporations, should be done in a clean environment, such as a Class-100 clean hood.

Coordination of the NIST technical measurements was under the direction of J.R. Moody of the NIST Analytical Chemistry Division.

The overall coordination of measurements performed by the U.S. Geological Survey, National Water Quality Laboratory, Arvada, CO and by laboratories that participate in the Standard Reference Water Program was under the direction of K. Long.

Statistical analysis of the experimental data was performed by S.B. Schiller of the NIST Statistical Engineering Division.

The technical and support aspects involved in the certification and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.S. Kane.

Gaithersburg, MD 20899
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Thomas E. Gills, Chief
Standard Reference Materials Program

Table 1. Certified Mass Concentrations (ρ)

Element	ρ (in mg/L)
Calcium	31.04 ± 0.50
Magnesium	7.989 ± 0.035
Potassium	2.356 ± 0.035
Sodium	22.07 ± 0.64

Element	ρ (in μg/L)	Element	ρ (in μg/L)
Aluminum	127.6 ± 3.5	Lead	18.15 ± 0.64
Antimony	54.1 ± 1.1	Lithium	16.50 ± 0.55
Arsenic	56.02 ± 0.73	Manganese	37.66 ± 0.83
Barium	506.5 ± 8.9	Molybdenum	112.9 ± 1.7
Beryllium	12.53 ± 0.28	Nickel	58.1 ± 2.7
Boron	144.8 ± 5.2	Selenium	11.43 ± 0.17
Cadmium	6.47 ± 0.37	Silver	1.270 ± 0.057
Chromium	18.53 ± 0.20	Strontium	294.8 ± 3.4
Cobalt	25.00 ± 0.59	Thallium	7.28 ± 0.25
Copper	20.5 ± 3.8	Vanadium	35.1 ± 1.4
Iron	91.2 ± 3.9	Zinc	72.48 ± 0.65

The mass density of SRM 1643d at 22 °C is 1.016 g/mL.

The certified values are equally weighted means of the results of two or more independent analytical methods. The expanded uncertainty [2], whose level of confidence is approximately 95 %, includes within-method sources of uncertainty which were statistically evaluated (Type A) or evaluated by other means (Type B). An allowance for the difference between methods was also included for the following elements: aluminum, barium, beryllium, boron, cadmium, calcium, cobalt, iron, lithium, manganese, nickel, potassium, sodium, strontium, thallium, and vanadium.

Additional elements present in this SRM, other than those certified, are listed below for information only.

Table 2. Noncertified Mass Concentrations (ρ)

Element	ρ (in μg/L)	Element	ρ (in mg/L)
Bismuth	13	Silicon	2.7
Rubidium	13		
Tellurium	1		

Source and Preparation of Material: SRM 1643d was prepared at the facilities of the U.S. Geological Survey, Quality Assurance Branch, Arvada,CO, under the direction of D. Erdmann and with the assistance of J.R. Moody of the NIST Analytical Chemistry Division. Only high-purity reagents were used; the containers were acid cleaned before use. In the preparation, a polyethylene cylindrical tank was filled with distilled water and sufficient nitric acid to make the solution approximately 0.5 mol/L. Solutions containing known amounts of elements to be determined were then added to the acidified water solution. After mixing thoroughly, the solution was filtered through 0.2 μm filters, sterilized by a flow-through ultraviolet light sterilizer, and then transferred to clean 250 mL polyethylene bottles.

Table 3. Methods Used for the Analysis of SRM 1643d

Methods	Elements
DCP, ETAAS, ICP-AES, ICPMS	Aluminum
ETAAS, Hyd-AAS, ICP-AES, ICPMS	Antimony
ETAAS, Hyd-AAS, ICP-AES, ICPMS, TXRF	Arsenic
ICP-AES, ICPMS, ID-ICPMS	Barium
ETAAS, ICP-AES, ICPMS	Beryllium
ICPMS, TXRF	Bismuth
ICP-AES, ICPMS	Boron
ETAAS, ICP-AES, ICPMS	Cadmium
FAAS, ICP-AES, ICPMS	Calcium
ETAAS, ICP-AES, ICPMS, TXRF	Chromium
ETAAS, ICP-AES, ICPMS, TXRF	Cobalt
FAAS, ETAAS, IC, ICP-AES, ICPMS	Copper
COLOR, FAAS, ETAAS, ICP-AES, ICPMS	Iron
FAAS, ETAAS, IC, ICP-AES, ICPMS, ID-ICPMS, TXRF	Lead
FAAS, ICP-AES, ICPMS	Lithium
DCP, FAAS, IC, ICP-AES, ICPMS	Magnesium
FAAS, ETAAS, ICP-AES, ICPMS, TXRF	Manganese
ETAAS, ICP-AES, ICPMS, ID-ICPMS, TXRF	Molybdenum
FAAS, ETAAS, IC, ICP-AES, ICPMS, ID-ICPMS, TXRF	Nickel
FES, FAAS, ETAAS, ICP-AES, ICPMS	Potassium
ICPMS, TXRF	Rubidium
ETAAS, Hyd-AAS, ICPMS, TXRF	Selenium
COLOR, ICP-AES, ICPMS	Silicon
ETAAS, ICP-AES, ICPMS, ID-ICPMS	Silver
DCP, FES, FAAS, ICP-AES, ICPMS	Sodium
FAAS, ICP-AES, ICPMS, ID-ICPMS, TXRF	Strontium
ICPMS	Tellurium
ID-ICPMS, ICPMS, TXRF	Thallium
ETAAS, ICP-AES, ICPMS, TXRF	Vanadium
FAAS, ICP-AES, ICPMS, TXRF	Zinc

Methods

COLOR	Colorimetry
DCP	Direct current plasma atomic emission spectrometry
ETAAS	Heated graphite atomizer (electrothermal) atomic absorption spectrometry
FAAS	Flame atomic absorption spectrometry
FES	Flame emission spectrometry
Hyd-AAS	Hydride generation atomic absorption spectrometry
IC	Ion chromatography
ICP-AES	Inductively coupled plasma atomic emission spectrometry
ICPMS	Inductively coupled plasma mass spectrometry
ID-ICPMS	Isotope dilution inductively coupled plasma mass spectrometry
TXRF	Total reflection x-ray fluorescence spectrometry

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GKSS Research Center, Geesthacht, Germany: U. Rues and A. Prange

REFERENCES

[1] Taylor, B.N., Guide for the Use of the International System of Units (SI), NIST Special Publication 811, 1995 Ed., (April 1995).

[2] *"Guide to the Expression of Uncertainty in Measurement"*, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993).